

## **CLAIMS**

1. In a belt or chain-driven motorcycle having a V-Twin engine with an extended crankshaft and having a battery and a cranking motor powered by the battery for rotating the crankshaft to start the engine; a direct drive cranking system comprising:

5 a ring gear affixed to said crankshaft for rotating said crankshaft;  
a sprag freewheel clutch mounted to said crankshaft in an overrunning operating configuration;

a cranking motor support arm having first and second support bearings located along parallel axes, one of said axes being co-axial with said crankshaft, said  
10 first support bearing receiving a free end of said crankshaft in rotational engagement;  
and

a cranking motor having a driven pinion gear for engaging said ring gear with a selected gear ratio, said pinion gear being received in said second support bearing along the other of said parallel axes.

2. The direct drive cranking system recited in claim 1 further comprising an engine sprocket gear affixed to said crankshaft for driving said belt or chain; said sprocket gear forming a portion of said sprag freewheel clutch.

3. The direct drive cranking system recited in claim 1 wherein said gear ratio is selected to operate said cranking motor and battery at about their maximum power points.

4. The direct drive cranking system recited in claim 1 wherein said cranking motor, said ring gear, said sprag freewheel clutch and said support arm are enclosed in an oil-filled sealed housing which also encloses one end of said crankshaft.

5. The direct drive cranking system recited in claim 1 wherein said pinion gear is driven by three planetary gears in said cranking motor.

6. In a belt or chain-driven motorcycle having a V-Twin engine with an extended crankshaft and having a battery and cranking motor powered by the battery for rotating the crankshaft to start the engine; a direct drive cranking system comprising:

- 5           a ring gear affixed to said crankshaft for rotating said crankshaft;
- a cranking motor having an output shaft mounted in parallel relation to said crankshaft for engaging said ring gear with a selected gear ratio; and
- a clutch for selectively engaging said cranking motor to said crankshaft.

7. The direct drive cranking system recited in claim 6 further comprising a sprocket gear for driving said belt or chain; said sprocket gear forming a portion of said clutch.

8. The direct drive cranking system recited in claim 6 wherein said gear ratio is selected to operate said cranking motor and said battery near their maximum power capabilities simultaneously.

9. The direct drive cranking system recited in claim 6 wherein said cranking motor, said ring gear and said clutch are enclosed in an oil-filled sealed housing which also encloses an end of said crankshaft.

10. The direct drive cranking system recited in claim 6 wherein said cranking motor comprises a pinion gear driven by three planetary gears in said cranking motor.

11. A method for converting a belt or chain-driven V-Twin engine motorcycle from a remote cranking system to a direct drive cranking system; the method comprising the steps of:

5 a) removing the existing cranking motor, integral cranking motor clutch and ring gear;

b) affixing a sprag freewheel clutch to the motor crankshaft;

c) affixing a new ring gear to the sprag freewheel clutch; and

d) positioning a cranking motor having a pinion gear to allow said pinion gear to engage said new ring gear.

12. The method recited in claim 11 further comprising the step of selecting the new ring gear and the pinion gear to provide a gearing ratio corresponding to operating conditions of the cranking motor and battery that allows the maximum amount of cranking power to be delivered to the crankshaft.

13. The method recited in claim 11 further comprising the step of modifying the cranking motor of step d) to provide increased cranking torque per unit starting current.

14. A method for converting a belt or chain-driven V-Twin engine motorcycle from a remote cranking system to a direct drive cranking system; the method comprising the steps of:

5 a) removing the existing cranking motor, integral cranking motor clutch and ring gear;

b) affixing an overrunning clutch to the motor crankshaft;

c) affixing a new ring gear to the overrunning clutch; and

d) positioning a cranking motor having a pinion gear to engage said new ring gear with said pinion gear.

15. The method recited in claim 14 further comprising the step of modifying the cranking motor of step d) to provide increased starting torque per unit starting current.

16. The method recited in claim 14 further comprising the step of selecting the new ring gear and the pinion gear to provide a gearing ratio corresponding to operating conditions of the cranking motor and battery that allows the maximum amount of cranking power to be delivered to the crankshaft.